UNIT 2

WATERSHEDS, RIPARIAN ZONES AND RIVER HABITAT

Introduction to Unit 2

Number of Lessons: 6

Duration of Unit: 3 weeks

Rationale/Overview: The purpose of this unit is for the students to familiarize themselves with watersheds and a local riparian zone, the role this area plays in the overall health of the watershed, and how it influences river habitat. Understanding how the riparian zone influences water will lead to the students more thoroughly understanding the issues with the Nechako white sturgeon. The goal is that awareness about the watershed, riparian zone and river habitat will enhance students' understanding of consequences from human activities and how they can prevent negative outcomes.

Background and Teacher Preparation Required: This unit is meant to be taught after Unit 1 Introduction, but can also follow Unit 3 The Nechako White Sturgeon.

Cross-Curricular Connections: Language Arts, Physical Education and/or Daily Physical Activity, Social Studies, Fine Arts

Overview of Lessons

LESSON 2-1: WATERSHEDS

Time of Lesson: 1 hour

Instruction Objectives: Student can identify the Nechako watershed, and define the areas of a watershed and how they are linked together.

Strategies and Activities: Review from introduction to watersheds, activity sheets and watershed demonstration kit.

Materials:

- Handout: *Worksheet 2a - Watersheds*
- Demonstration: *Watershed Kit*
- Handout: *Worksheet 2b - The Nechako Watershed*
- SMARTboard Interactive Activities: *Watershed Definitions & Watershed Definitions-Matching*

LESSON 2-2: RIPARIAN ZONES

Time of Lesson: 1 hour

Instruction Objectives: Student understand what a riparian zone is, what makes a healthy riparian zone, and why it is important for watershed health.

Strategies and Activities: Discussion about riparian zones, PowerPoint presentation and art activity.

Materials:

- SMARTboard PowerPoint presentation: *Riparian Zones*
- Riparian art activity: drawing a riparian zone

LESSON 2-3: RIPARIAN ZONES AND BIODIVERSITY

Time of Lesson: 1.5 hours

Instruction Objectives: Student can define biodiversity and retell how organisms are linked in the ecosystem. Students can understand impacts by humans on riparian zone habitat.

Strategies and Activities: Discussion about biodiversity, explore concept of ecosystem. Create a cartoon style poster depicting organism interactions in an ecosystem.

Materials:

- SMARTboard PowerPoint presentation: *The Fallen Leaf*.
- Handout: *Worksheet 2c - The Fallen Leaf*.
- Activity: *Worksheet 2d - Ecosystem Cartoon*.

LESSON 2-4: NECHAKO WHITE STURGEON HABITAT AND HUMANS

Time of Lesson: 1.5 hours

Instruction Objectives: Students understand the basic habitat needs of Nechako white sturgeon. Students can identify human made impacts to riparian zones that impact biodiversity, river habitat, water quality and watershed health. Relate these impacts to Nechako white sturgeon.

Strategies and Activities: Read and discuss the poem *Sturgeon*, review sturgeon habitat needs and discuss impacts by humans on sturgeon habitat. Create a poem about Nechako white sturgeon.

Materials:

- Handout: *Worksheet 2e - Sturgeon Poem.* Go to http://www.lornacrozier.ca for more information about the poet.
- Handout: *Worksheet 2f - Habitat Requirements T-Chart.*
- SMARTboard Interactive Activity: *Habitat T-Chart.*
- Experiment: *2 glass jars, access to water tap, a sunny spot and a shady spot in the classroom, thermometre.*
- Activity: Paper, pens, pencils to create poem.

LESSON 2-5: RECOVERY AND REHABILITATION

Time of Lesson: 1.5 hours

Instruction Objectives: Students can identify restoration and rehabilitation projects in the Nechako Watershed specific to Nechako white sturgeon and overall watershed health.

Strategies and Activities: Definitions of recovery and rehabilitation. Review different types of project occurring for Nechako white sturgeon. Design a recovery/ rehabilitation project.

Materials:

- PowerPoint presentation: *Recovery and Rehabilitation*.
- Handout: *Worksheet 2g - Recovery and Rehabilitation*.
- Activity: Restoration project - paper, markers, pencils and other craft material.

LESSON 2-6: RIPARIAN ZONES FIELD TRIP

Time of Lesson: 2 hours

Instruction Objectives: Student apply their classroom learning to the field.

Strategies and Activities: Students record observations and drawings of the riparian zone, do a species count and, if possible, a comparison between a mature and immature riparian zone.

Materials:

- Handout: *Worksheet 2c - Riparian Zones (if not completed in class in earlier lesson)*.
- Handout: *Worksheet 2h - Biodiversity Inventory*.
- Pencils, clipboards, paper, class camera
- Guest Speaker: please contact NWSRI for a list of possible guest speakers to accompany your class. Alternatively, if you know of any biologists please invite them to attend and lead the students through the material.

Lesson 2-1: Watersheds

Time of Lesson: 1 hour

Rationale: The purpose of this lesson is to introduce the Nechako watershed and for the students to develop a sense of place. People's empathy for special places strengthens their commitment to stewardship of our natural environment. Additionally, our local history is strongly tied to the Nechako River, as First Nations along with the first explorers and settlers used the Nechako River within the watershed for survival. Constructing a sense of place has a key role in developing education and interpretation material about our natural and cultural environment.

Instructional Objectives: Student can identify the Nechako watershed, and define the areas of a watershed and how they are linked together.

Strategies and Activities: Review from introduction to watersheds, activity sheet and watershed demonstration kit.

Materials:

- Handout: *Worksheet 2a - Watersheds*
- SMARTboard activity: *Watershed Definitions (.notebook file)*
- SMARTboard activity: *Watershed Definitions-Matching (.notebook file)*
- Demonstration: *Watershed Demonstration Kit.* It is recommended that teachers be familiar with the unit before presenting to the class. The Kit is available upon request. Please contact the Nechako White Sturgeon Recovery Initiative.
- Digital Image: *Nechako Watershed.jpg*

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to identify features and locations on a map that relate to watersheds.
- Ability to relate our actions within the watershed as negative or positive toward watershed health.

LESSON PLAN

Introduction (5 minutes)

Introduce the new Unit and the rational:

- To identify watersheds and riparian zones and relate to biodiversity, river habitat and Nechako white sturgeon.
- To gain a deeper awareness of the environment of the endangered Nechako white sturgeon and the many challenges the species currently faces.

Activity (5 minutes)

Quickly review what the class learned about watersheds in the introductory unit. Write their comments on the white board.

Key Points

splits up the landscape into areas where overland and percolating water comes to a common area (river or lake).

everything we do in the watershed impacts the overall health of the watershed.

the Nechako watershed is made up of over 30 sub basins or smaller watersheds that feed the river.

a watershed is made up of many parts (e.g. towns, riparian zones, lakes etc.)

humans, animals and plants all live together within a watershed.

Activity (10 minutes)

Hand out to the class *Worksheet 2a: Watersheds*.

Put on the SMARTboard: *Watershed Definitions or* SMARTboard: *Watershed Definitions-Matching*. Have the students fill in the definitions of the components of a watershed starting from the top of the watershed (ridge) to the bottom (mainstem river) working with the SMARTboard.

- Watershed: The area of land where all of the water that is within it or drains into the same place – either a lake, marsh, stream, river or groundwater.
- Riparian Zone: Land immediately adjacent a river or lake. The land of the riparian zone is influenced by the water table of the river or lake.
- Tributary: A river that flows into another river.
- Mainstem River: A river that flows into the ocean or the largest river in a watershed.
- Wetland: An area of saturated land that has water tolerant plants growing. Examples are swamps, ponds and bogs.
- Watershed Divide: The ridge that separates one watershed from another.
- Sub Basin: A watershed within a watershed.
- Precipitation: A form of water that falls from the sky. Can be rain, snow or hail.
- Overland Flow: Water that flows over the land or ground.
- Percolation: Water or liquids that filters through the soil below the surface of the ground. Underground flow.
- Groundwater: Water held underground in the soil or in the pores and crevices of rocks.

Ask

What are two potential paths for water that originates at the watershed ridge to get to a mainstem river? *Water can flow overland, through developed (agricultural lands, towns, industrial areas) or natural areas (forests). Water can percolate and flow underground through the soil.*

Have students colour in their hardcopy watershed diagrams.

Transition to next activity.

Activity (25 minutes)

Bring out the *Watershed Demonstration Kit*. Ask for student participation to help run the model. The model:

- shows how water flows through the soil (groundwater).
- shows how water picks up toxins and chemicals present on the surface of the ground and carries them through the soil to groundwater sources.
- shows the influence of wells on groundwater sources.

Ask

What does this model show us about how water moves through the watershed?

What actions do humans do within the watershed that influence the quality of water in our rivers and groundwater?

e.g. driving automobiles releases toxins and chemicals into the air (caught by precipitation) and onto the ground (overland flow after rain) and get taken into the rivers.

e.g. pesticides or fertilizers on fields percolate into the ground or get carried via overland flow into our rivers.

Transition to next activity.

Activity (15 minutes)

On the SMARTboard (digital file *Nechako Watershed.jpg*) or on the hardcopy map on the wall, show the map of the Nechako watershed. Ask the class the following questions, pointing out or marking their answers on the map.

Ask

Where is our community on the map?

Where is somewhere special you went this summer?

Do you have family or a friend from a different community? Where do they live?

Considering what we just learned about how water flows over and through a watershed, ask students to consider positive and negative actions in the watershed.

Ask

Which of your actions in these places negatively or positively impacted the watershed? *Answers will vary, examples include:*

long distance driving = negative
fished from shore instead of a boat = positive
biked to school today = positive
littered plastic food wrapper in the trail along the river = negative

Hand out *Worksheet 2b: The Nechako Watershed*. Have students expand on the class discussion and mark their own maps. This worksheet could be sent home or completed as a review at the beginning of the next lesson.

Closure (5 minutes)

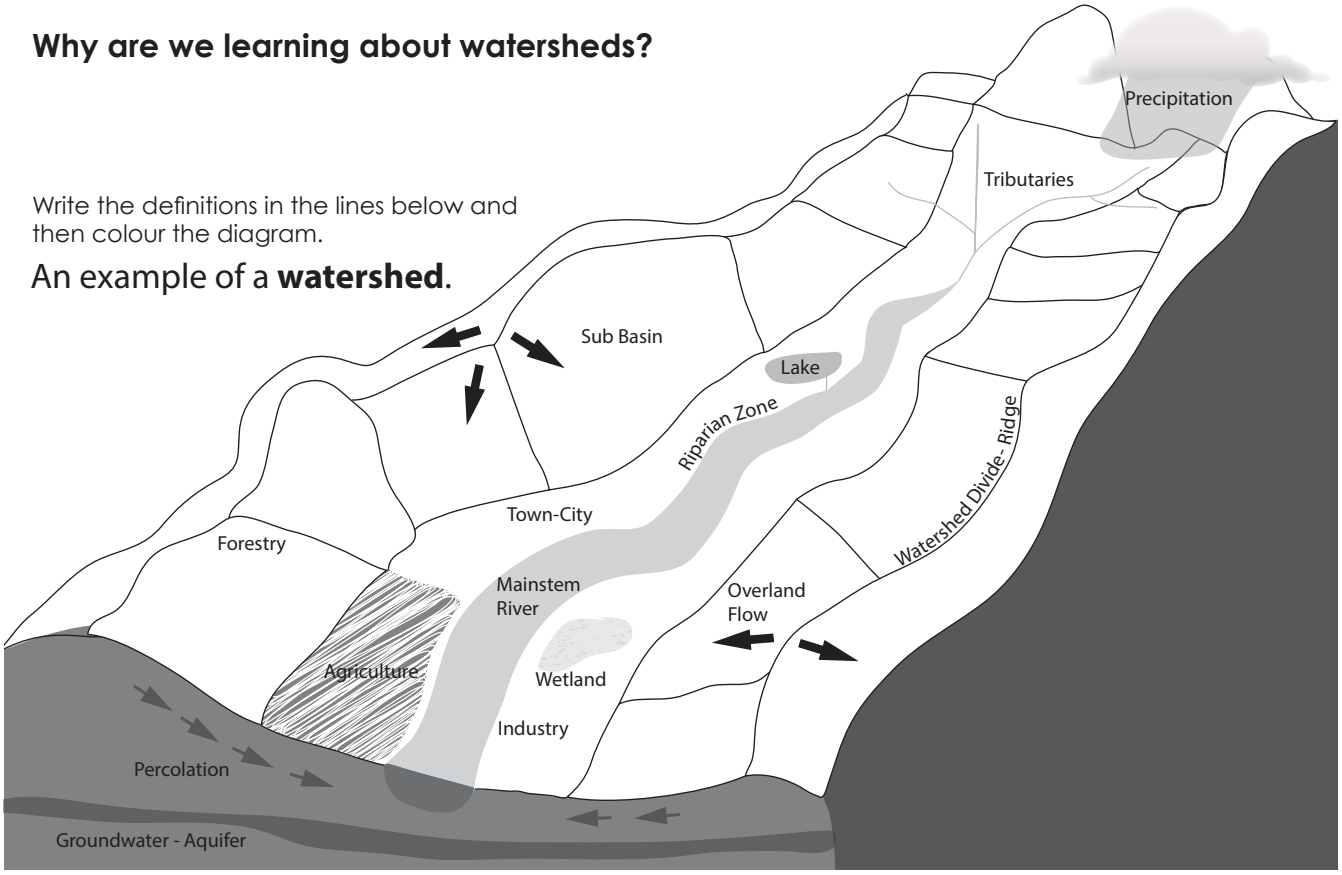
Ask students to make note of their actions for the rest of the day and what those actions mean to the watershed.

Watersheds

Why are we learning about watersheds?

Write the definitions in the lines below and then colour the diagram.

An example of a **watershed**.



Definitions

Watershed: _____

Riparian Zone: _____

Tributary: _____

Mainstem River: _____

Wetland: _____

Watershed Divide: _____

Sub Basin: _____

Precipitation: _____

Overland Flow: _____

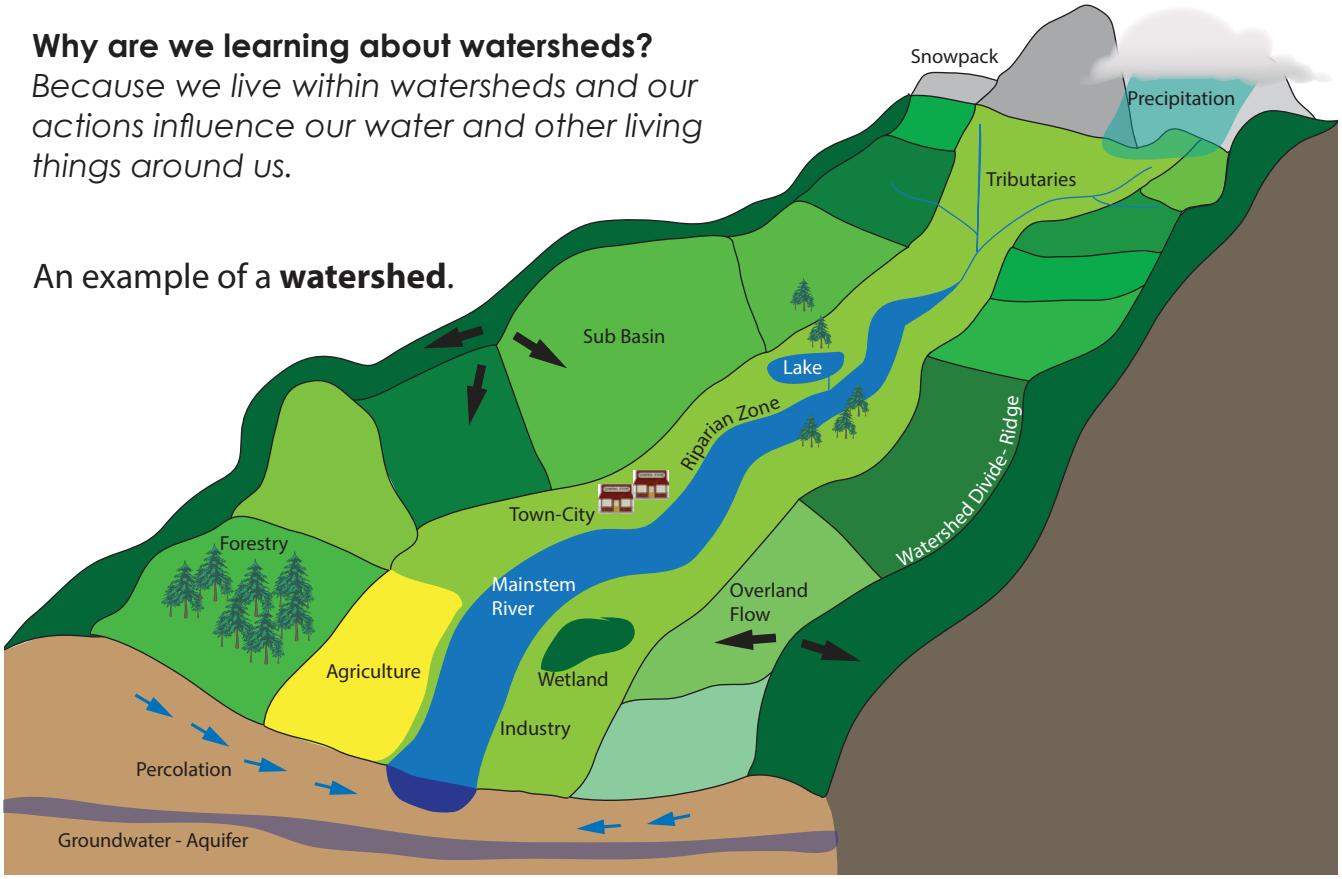
Percolation: _____

Groundwater: _____

Watersheds - Answer Key

Why are we learning about watersheds?
Because we live within watersheds and our actions influence our water and other living things around us.

An example of a **watershed**.



Definitions

Watershed: The area of land where all of the water that is within it or drains into the same place – either a lake, marsh, stream, river or groundwater.

Riparian Zone: Land immediately adjacent a river or lake. The land of the riparian zone is influenced by the water table of the river or lake.

Tributary: A river that flows into another river.

Mainstem River: A river that flows into the ocean or the largest river in a watershed.

Wetland: An area of saturated land that has water tolerant plants growing. Examples are swamps, ponds and bogs.

Watershed Divide: The ridge that separates one watershed from another.

Sub Basin: A watershed within a watershed.

Precipitation: A form of water that falls from the sky. Can be rain, snow or hail.

Overland Flow: Water that flows over the land or ground.

Percolation: Water or liquids that filters through the soil below the surface of the ground. Underground flow.

Groundwater: Water held underground in the soil or in the pores and crevices of rocks.

The Nechako Watershed

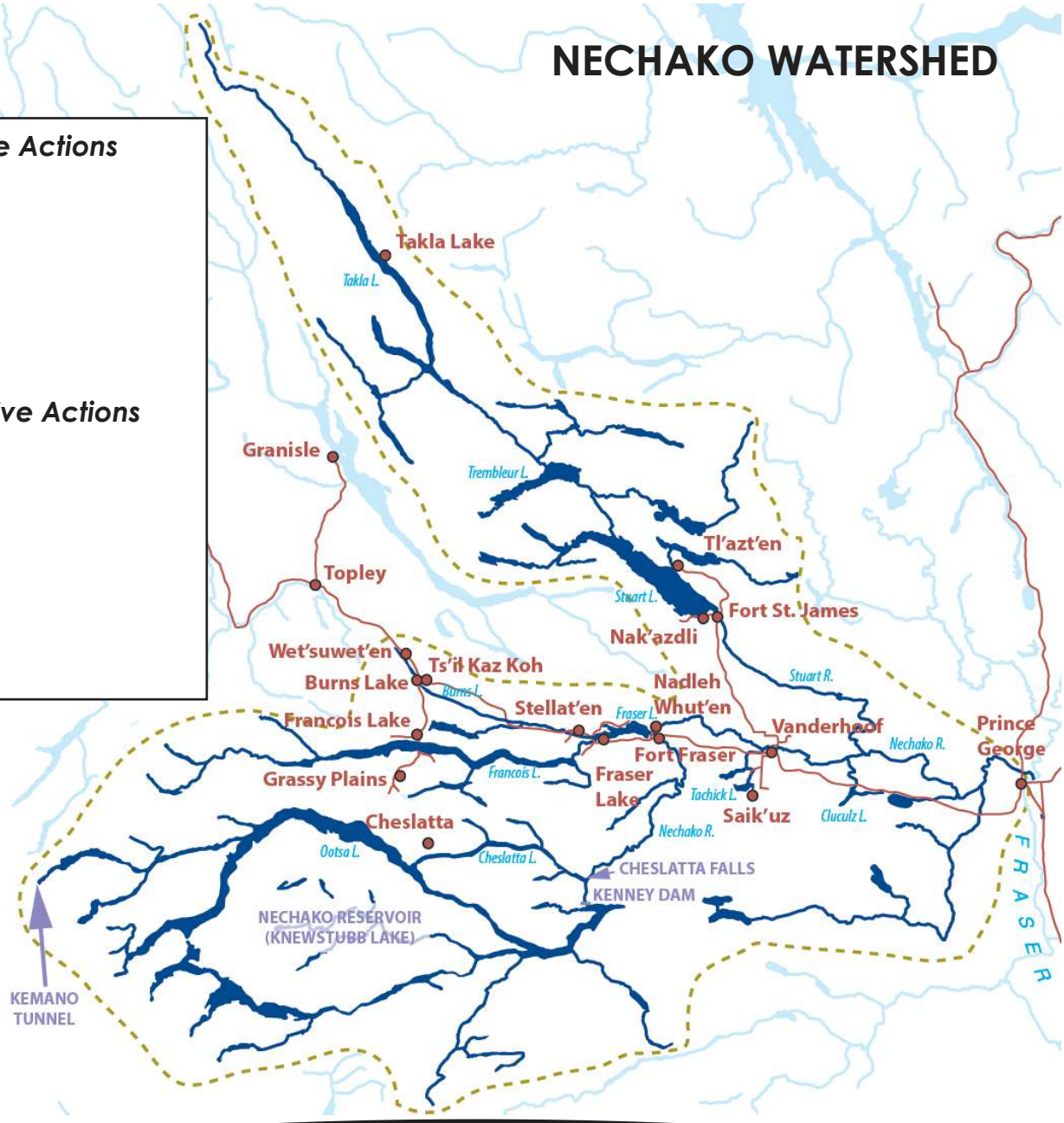
We live within the **Nechako watershed**. The Nechako watershed is made up of over 30 smaller river systems (sub basins). The Nechako River watershed is part of the larger Fraser River watershed. Nechako white sturgeon live within the waters of the Nechako watershed. On the map below, mark the following locations:

- where you are right now
- where you live
- two places you have visited
- the landfill for your community
- the place you shop for groceries
- where your parents work

Everything we do on the landscape has an impact on the watershed our water and the animals - e.g. Nechako white sturgeon - and humans that live within it. List three positive and three negative actions that occur (by you or others) in the places you marked on the map.

Positive Actions

Negative Actions



Lesson 2-2: Riparian Zones

Time of Lesson: 1 hour

Rationale: The purpose of this lesson is to define what a riparian zone is and link its importance for fish and other animals, humans, and the ecosystem in general.

Instructional Objectives: Student can define what a riparian zone is and list the reasons why riparian zones are important. Students can list negative and positive impacts to riparian zones.

Strategies and Activities: Brainstorming on what a riparian zone is and use handouts and PowerPoint presentations to present concepts.

Materials:

- SMARTboard PowerPoint presentation: *Riparian Zones*
- Handout: *Worksheet 2c - Riparian Areas*
- Handout: *Map of the Nechako Watershed*
- Paper and markers

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to identify where a riparian zone is on a landscape.
- Understanding of the features and importance of riparian zones.

LESSON PLAN

Review (5 minutes)

Review the definition of a riparian zone from the last lesson and where a riparian zone is within a watershed. Provide Handout *Worksheet 2c - Riparian Areas* as a review of what a riparian zone is. You can refer to this worksheet throughout the lesson.

Key Points

Riparian zone is the land immediately adjacent a lake or river. The soil in a riparian zone is influenced from the water of the lake or river and is composed of moist to saturated soils.

Riparian zones follow along the entire length of any creek or river in a watershed, or surround lakes and wetlands. The width of a riparian zone depends on the size of the river or lake (wider for larger rivers, narrower for creeks).

Water-loving plant species live within riparian zones.

Activity (25 minutes)

Display on the SMARTboard the PowerPoint presentation *Riparian Zones*. Flip through the first four slides that show images.

Ask

What do all these photographs show? *The riparian zone of different rivers of different sizes.*

Continue with the slideshow. Stop where necessary to discuss. There a several slides that have a lot of information on them that outlines why riparian zones are important.

- Riparian zones are important because they connect the water with the land, and host a wide range of plant and animal life.
- They keep water cool and clean. Along the edge of the water where it is shallow, trees and vegetation provide shade and moderate the water temperature during warmer weather. This prevents algae growth.
- They connect different ecosystems, transport/circulate nutrients, and allow wildlife to travel between different habitats.

The slideshow continues and presents several concepts of ecosystems and connections between plants, animals and water within the riparian zone.

Plants play a huge part in the riparian zone.

- adapted to wet conditions and can tolerate periodic flooding
- moderate the temperature in the water
- roots and plants provide stability and strength
- leaves, twigs, and needles provide nutrients to aquatic invertebrates, which in turn nourish fish
- large trees that have fallen into water, help slow down the energy of flowing water, protect stream banks, and create pools and hiding places for fish

Animals benefit from a healthy riparian zone because:

- birds and mammals help to disperse the seeds of shrubs and trees
- invertebrates, molluscs (slugs and snails), and worms help to break down plant and animal matter, making it more readily available as nutrients to other organisms
- salmon fulfill a unique role by connecting the ocean, freshwater, and the land during the course of their life cycle (which begins and ends in stream corridors)
- complex predator-prey relationships that help maintaining a healthy balance among species
- habitat for a huge array of animals (80% of wildlife depend on this area in whole or in part)

Humans benefit from riparian zones because:

- cleaner water
- improved waterhsed health - good for us too!
- fertile and productive for agriculture
- reduce energy during floods
- good often flat locations to build towns, industry and transportation routes
- store and trap sediments and contaminants
- scenic areas to live, walk or recreate.

Activity (25 minutes)

Distribute craft supplies including paper and markers. Have the students illustrate a healthy riparian zone. Have them be detailed in the:

- varying height of plants and number of different type of plants (water loving)
- as many animal species as they can think would live in a riparian zone
- different aquatic species and organisms in the water (fish, invertebrates, detritus (rotting plant matter).

Display art work in classroom or in hallway outside classroom. If time permits, have classroom discussion on each person's work, or split into smaller groups and have students share their work with each other.

Closure (5 minutes)

Review what makes a riparian zone healthy.

Riparian Areas

The **riparian zone** is the area of land adjacent to streams, rivers, lakes and wetlands, where the vegetation and soils are strongly influenced by the presence of water.

Riparian areas are important for plants, animals, humans, water quality and overall watershed health. Riparian zones connect the land with water.

A healthy riparian zone:

Has a diversity of plants to the banks of the water that provide shade to the water

Has a diversity of animals living within it

Is as least as wide as the tall trees in the riparian zone

A healthy riparian zone will:

Reduce energy during floods

Provide habitat for animals (birds, mammals, insects, fish, reptiles, invertebrates)

Store nutrients and contaminants

Provide structure and stability to river banks

Filter and reduce energy of overland flow

Regulate water temperature

Provide corridors for animals to travel

Be an area of increased biodiversity

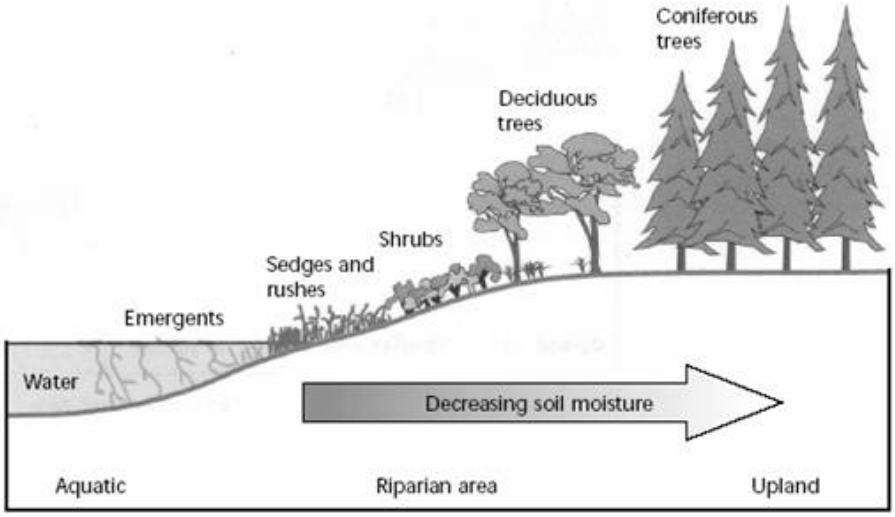


FIGURE 1 *Illustration of the moisture gradient in a typical riparian ecosystem (from Stevens et al. 1995:2).*

Impacts of Land Use in Riparian Zones

People have long relied on riparian zones for the abundant food, water, and material resources they supply. Riparian areas are often flat making it easier to build roads, farms, and towns in them. Therefore, many riparian areas have been built on for different ***land uses*** *(e.g. agriculture).*

Land use and development in riparian zones comes at a price! Impacts from development of riparian areas include:

- *contamination and pollution of water*
- *loss of vegetation and biodiversity*
- *increased erosion of river banks leading to altered river habitat*
- *increased water temperature*
- *ability for invasive species to grow*

Below list 3 different land uses that occur along the Nechako River. Tick if they are beneficial (positive) or detrimental (negative) to riparian health.

Land Use Practices	**Positive**	**Negative**
_____	❑	❑
_____	❑	❑
_____	❑	❑

Lesson 2-3: Riparian Zones and Biodiversity

Time of Lesson: 1.5 hours

Instruction Objectives: Student can define biodiversity and retell how organizes are linked in the ecosystem. Students can make the link between sturgeon and riparian zone health.

Strategies and Activities: Discussion about biodiversity, explore concept of ecosystem, create a poem of the importance of biodiversity in a riparian zone.

Materials:

- SMARTboard PowerPoint presentation: *The Fallen Leaf*.
- Handout: *Worksheet 2d - The Fallen Leaf*.
- Activity: *Worksheet 2e - Ecosystem Cartoon*.

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to identify how organisms, ecosystems and biodiversity link together.
- Understanding of how humans influence the riparian zone ecosystem.

LESSON PLAN

Introduction (20 minutes)

Discuss the definitions of organism, ecosystem and biodiversity.

Organism: Individual animal, plant, or single-celled life form.

Ecosystem: A biological community of interacting organisms and their physical environment.

Biodiversity: The variety of life in the world or in a particular habitat or ecosystem.

Key Points

Different places on the earth have different numbers and variety of organisms. Each organism plays a part in the functioning of the ecosystem. Biodiversity is the count of how many organisms and the different types of organisms live within an ecosystem.

In general, the higher the biodiversity, the healthier the ecosystem.

The organism may be as small as a leaf, or as large as a sturgeon - they all have their important role in keeping the ecosystem functioning.

If one organism is removed (through extirpation or extinction) then the ecosystem either fails (other organisms can not succeed/survive or invasive organisms enter the ecosystem), or the organisms within the ecosystem have to adapt.

Activity (30 minutes)

Display on the SMARTboard the PowerPoint presentation *A Fallen Leaf* (the presentation includes a short animation that shows the connection between different organisms within the riparian zone).

Key Points

The variety of organisms in the riparian zone each add to the success or health of the riparian zone.

A healthy riparian zone includes all the links between organisms.

Either before or after the animation is shown, give students the Handout *Worksheet 2c: The Fallen Leaf*. Allow students to fill in the answers as the animation is shown, pause at the appropriate times, or use the Handout as a review after the animation is complete.

Begin the presentation and pause where discussion is needed.

At the end of the PowerPoint presentation, review the cycle and consider where humans fit into the cycle of the leaf. Brainstorm with the students what impacts on biodiversity humans have, particularly in the riparian zone.

Ask

Where do humans fit in the cycle and how do we influence the ecosystem in the riparian area? *Humans have an impact at almost every step. Below are some examples:*

- *humans cut down trees in the riparian zone - remove leaves from the forest and material to feed microorganisms*
- *this also reduces the amount of trees that fall into the water that create habitat for fish and invertebrates*
- *humans put chemicals onto the ground and into the water - poor conditions for invertebrates to live*
- *humans capture fish - less food for larger fish as well as land predators like bear*
- *Ask the students for positive human impacts in a riparian zone*

Transition to next activity.

Activity (30 minutes)

Split the class into small groups or as individuals and take out pens and paper. Have the students create a 4 scene cartoon about organism interactions in a riparian zone. The cartoon can show a different example of a cycle like the *Fallen Leaf*, or it can be about one part of the cycle (e.g. fish eating invertebrates). Be creative!

Review (10 minutes)

Ask

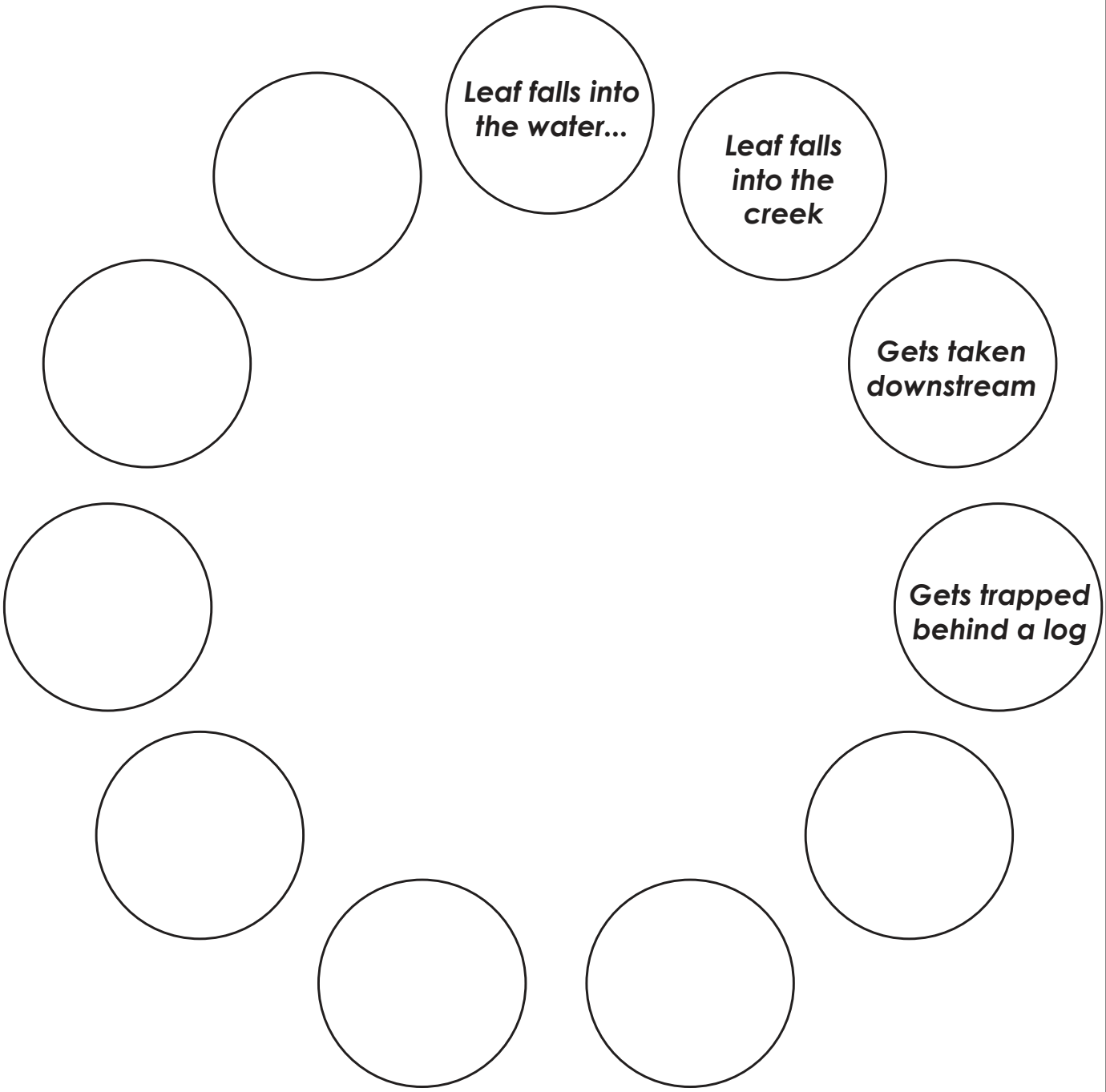
Considering all we have learned so far, why do we find higher biodiversity within the riparian zone? *Connection between land and water, lush vegetation due to presence of water, many areas for shelter for different organisms, abundance of food and water.*

The Fallen Leaf

A leaf falls from a tree in the riparian zone. What happens?

Fill in the circles with the next steps in the life cycle of the leaf and ecosystem. When you are done, illustrate the story in the centre of the circle.

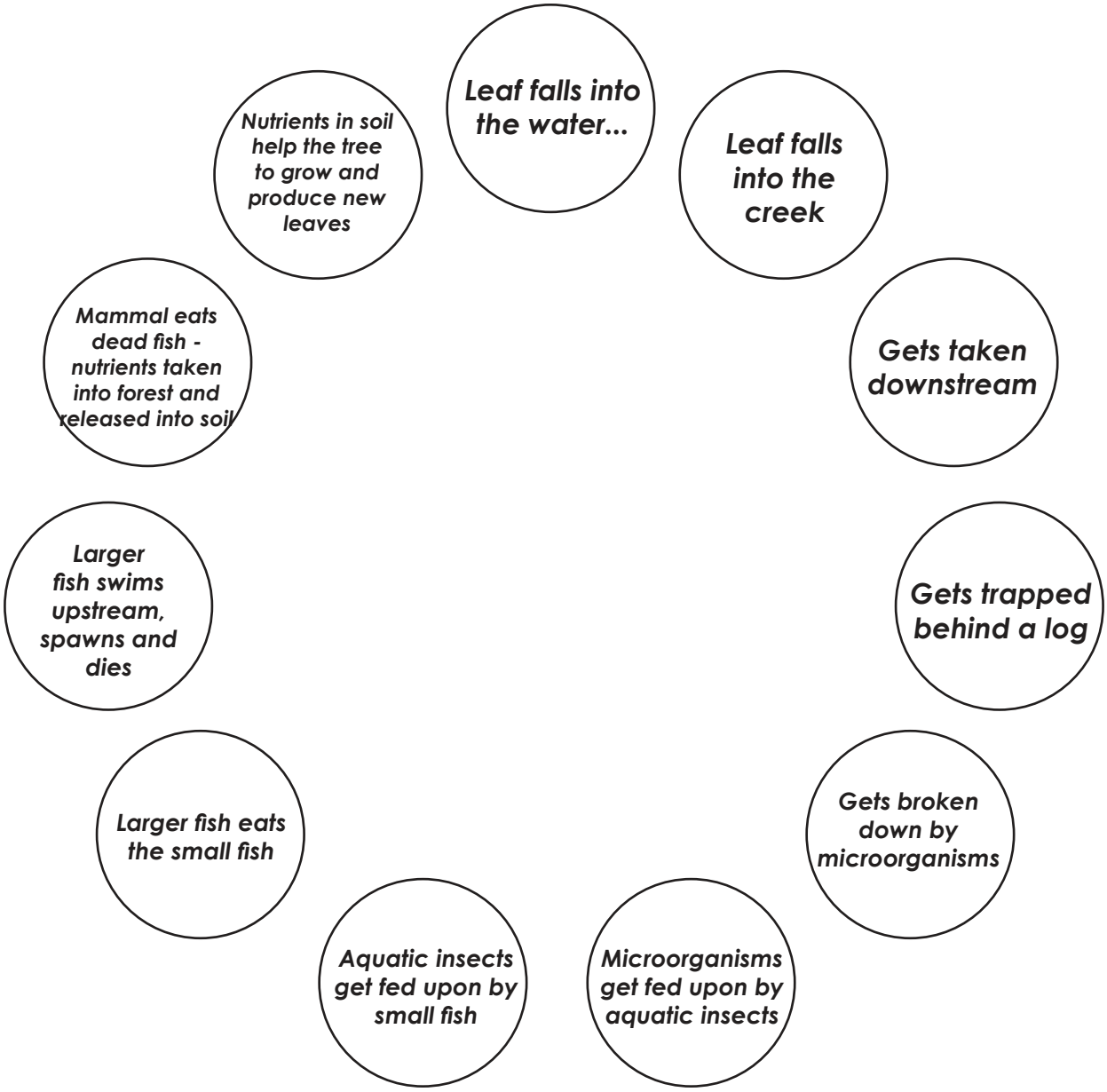
BONUS: Where would humans be put into this cycle? How do humans influence this cycle?



The Fallen Leaf - Answer Key

A leaf falls from a tree in the riparian zone. What happens?

Fill in the circles with the next steps in the life cycle of the leaf and ecosystem. When you are done, illustrate the story in the centre of the circle.



Ecosystem Cartoon

Create your own ecosystem cartoon, showing organisms interacting (in funny ways) in a cycle like the *Fallen Leaf*. Or pick a part of the cycle and have some fun illustrating what is happening. Your cartoon can be set in a healthy or unhealthy riparian zone - up to you.

Be creative and have fun!

Lesson 2-4: Nechako White Sturgeon Habitat and Humans

Time of Lesson: 1.5 hours

Instruction Objectives: Students understand the basic habitat needs of Nechako white sturgeon. Students can identify human made impacts to riparian zones that impact biodiversity, river habitat, water quality and watershed health. Relate these impacts to Nechako white sturgeon.

Strategies and Activities: Read and discuss the poem *Sturgeon*, review sturgeon habitat needs and discuss impacts by humans on sturgeon habitat. Create a poem about Nechako white sturgeon.

Materials:

- Handout: *Worksheet 2e - Sturgeon Poem.* Go to http://www.lornacrozier.ca for more information about the poet.
- Handout: *Worksheet 2f - Habitat Requirements T-Chart.*
- SMARTboard Interactive Activity: *Habitat T-Chart*
- Experiment: *2 glass jars, access to water tap, a sunny spot and a shady spot in the classroom, thermometre.*
- Activity: Paper, pens, pencils to create poem.

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to identify basic habitat needs of Nechako white sturgeon.
- Understanding of how humans influence sturgeon habitat specifically in the Nechako Watershed.

LESSON PLAN

Experiment (5 minutes)

Conduct an in-class experiment. Fill two jars up with water. Place one in the sun and one in the shade. Leave the jars for at least 30 minutes. The jars will be discussed later in the lesson.

Ask

What do you think this experiment is testing for? *Test how having no shade can increase the water temperature.*

What do you predict will be the outcome? *Sunny jar will be warmer.*

Introduction (20 minutes)

Discuss the habitat requirements of Nechako white sturgeon. This topic will be covered in more detail in Unit 3, however a basic understanding is needed here to help relate sturgeon population health to river habitat, riparian zone ecosystem, watershed health and human influences.

On the white board, brainstorm the habitat requirements of Nechako white sturgeon.

Ask

What are the habitat requirements of sturgeon - or in other words, what types of areas or conditions do Nechako white sturgeon need in the river to survive? Consider the different life stages.

<u>Eggs</u>

- Clean, rocky substrate in turbulent river habitats (eggs stick to rocks)
- Temperatures of 14 – 18 degrees Celcius for optimum incubation
- POOR HABITAT: extreme water temperatures, abrupt temperature changes, contaminants, shallow water, low velocity, sediment accumulation silt, sandy river bottom

<u>Larvae</u>

- Require clean, rocky substrate in turbulent river habitats (for hiding and eating)
- POOR HABITAT: extreme water temperatures, abrupt temperature changes, contaminants, shallow water, low velocity, silt, increased water clarity, reduced food availability

<u>Juveniles/Sub-adults/Mature adult population</u>

- Deep pools, slow back eddies (to hide and rest)
- Lakes in the winter months (sometimes)
- Fast flowing areas below rapids (good place to get food)
- Prefer deep and faster flowing areas to spawn

Transition to next activity.

Activity (30 minutes)

Pass out the Handout *Worksheet 2e - Sturgeon Poem.* Read the poem out loud to the class. Stop to provide definitions of words or explain ideas. Have the students write comments or draw images of what they understand about the poem on the Handout. Allow for a classroom discussion.

Ask

What does this poem tell us about Nechako white sturgeon habitat? *Inhabits deep, cool water. In lakes. They live and eat at the bottom of the river or lake.*

What else does this poem tell us? *Human catch and eat sturgeon. Humans don't fully understand the sturgeon and our actions have an impact on their overall survival.*

Transition to next activity.

Experiment (15 minutes)

Recover the jars and record the water temperature from each jar. Write these on the white board and discuss the results. The results should show that the sunny jar was warmer. As previously discussed, eggs and young sturgeon and salmon do not prefer warm water temperatures. Salmon are a food source for sturgeon. If water temperature is too high, salmon survival is low and there is less food for sturgeon.

Ask

What factors cause water temperature in a river to rise? *Reduced riparian zone/vegetation that shades the river and water. Shallower water from dam activity or a naturally dry season.*

Are these factors natural or human made? *Both but mostly human made.*

Relate the discussion back to Nechako white sturgeon and the Nechako River.

This experiment is just one example of how humans can have an impact on riparian ecosystem health and river habitat, particularly for sturgeon and other fish that they eat. Hand out *Worksheet 2f - Habitat Requirements T-Chart*. Use the SMARTboard Interactive Activity: *Habitat T-Chart* on the SMARTboard if desired.

Ask

List other human impacts to sturgeon habitat and their food sources (salmon and invertebrates) that are specific to the Nechako Watershed.

Often culverts under roads (paved and gravel roads) are not installed properly and they block access for smaller fish (food source) to their spawning areas, thereby reducing the amount of small fish to feed upon.

Kenney Dam reduces the overall amount of water and depth of the river. This can be harmful for spawning, eggs and juvenile fish in particular.

Logging and agricultural practices tend to reduce the amount of riparian vegetation available along rivers, which can affect water temperature, food source and bank stability (additional sediment from erosion of stream banks can cover gravel beds needed for eggs and small sturgeon).

Transition to next activity.

Activity (20 minutes)

Have students work individually or in groups to create an original poem about the Nechako white sturgeon. Use the poem *Sturgeon* as an example, however the students' poem can be as simple as two or three lines. The poem should include details about sturgeon habitat and what factors impact their habitat and survival.

If time permits, have the students illustrate their poems and either present orally to the class or post on the wall for other classes to read.

Sturgeon Poem

Read the poem *Sturgeon*. This is a free verse poem with ideas that flow like ripples in a river. Remember when you read to follow the punctuation marks so the meaning is clear. Use the space beside the poem to write or draw what you understand about the poem. What is happening to the sturgeon in the poem? Where does the sturgeon spent its time within the river? Does the poet tell a happy or sad story in this poem?

Sturgeon
By Lorna Crozier
(from Inventing the Hawk)

Bottom feeders, the sturgeon move
their long snouts through the darkest part
of water, unchanged, Antediluvian
they are older than the oldest man,
older than any spirits of the air
Grandmother, grandfather, fish,
surely they are holy, worshipped
by the shamans when our world
was full of wonder. Too huge to hold
in the mind, they may be
what we have called Ogopogo, Loch Ness
fabulous, long-necked monsters
of the lakes, solitary, shy of man…
They are a heavy, bony fish
with thick sucking lips. They are
edible, their eggs consumed as caviar
black translucent pearls
the female lays after twenty years
without a mate.
Though they move
where light cannot reach them
as we move each night in dream,
unchanged, we pull them from
the bottoms of lake or river or sea
without awe or mercy,
thrust them into the sun
their old toothless mouths large as caves
their stunned eyes holding at the last
instant of their ancient lives
a human face.

Habitat Requirements T-Chart

Fill in the following chart with what you have learned about sturgeon habitat needs and how humans impact them (negatively and positively) in the Nechako Watershed.

Nechako white sturgeon habitat requirements	***Human Impacts in the Nechako Watershed***

Lesson 2-5: Recovery and Rehabilitation

Time of Lesson: 1.5 hours

Instruction Objectives: Students can identify restoration and rehabilitation projects in the Nechako Watershed specific to Nechako white sturgeon and overall watershed health.

Strategies and Activities: Definitions of recovery and rehabilitation. Review different types of project occurring for Nechako white sturgeon. Design a recovery/ rehabilitation project.

Materials:

- PowerPoint presentation: *Recovery and Rehabilitation*.
- Handout: *Worksheet 2g - Recovery and Rehabilitation*.
- Activity: Restoration project - paper, markers, pencils and other craft material.
- Take home Handout: *Home Tips for Healthy Streams*

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to define terms in lesson.
- Ability to identify areas along the river that need rehabilitation and why.

Review (10 minutes)

Review habitat requirements of Nechako white sturgeon and impacts from humans on these habitats from previous lesson.

Activity (20 minutes)

Bring up the PowerPoint presentation *Recovery and Rehabilitation* on the SMARTboard. The beginning of the slideshow is review from the first introductory lesson (Unit 1 Lesson 1-1). Flip through these slides and review information.

Stop at the 'First Definitions' slide and go through these two important definitions.

> Recovery: a return to a normal state of health (of the population). Currently the population is so low that it needs help in recovering to a healthy level (over 2,500 animals). The population should also be self-sustaining in that it does not require the help of humans to sustain it through a hatchery program.
>
> Rehabilitation: return to its former condition. Currently the shape, riparian zone and water in the Nechako River are very different than they were 20, 50, 100 years ago. Rehabilitation of areas along the river banks (e.g. planting trees) helps return the habitat to its previous condition. You can also use the word 'restoration'.

The remaining slides show some of the work being done by the NWSRI. The list is not complete. Please visit www.nechakowhitesturgeon.org for an up-to-date list of Current Projects. This section of the slideshow is intended to give examples of recovery and rehabilitation projects that can occur to help Nechako white sturgeon. It is not intended that the students understand the science or methodology of any of these projects.

> *Key Points*
>
> Research has to occur at all levels, from eggs to adult fish (food and growth), habitat (where they spawn, rest, eat), to water quality (what conditions are best). Often research leads to new questions and more research.
>
> Public awareness is a huge part of recovery and rehabilitation.

Transition to next activity.

Activity (45 minutes)

Based on the information covered in this lesson and what the students have learned about human impacts to sturgeon habitat, have the students create a recovery or rehabilitation project/plan for Nechako white sturgeon.

Working individually or in small groups, use *Worksheet 2g - Recovery and Rehabilitation* as a starting point.

The project can be for any part of the sturgeon life cycle, a specific location on the Nechako River, it can include further research, etc. The projects should Include:

- The goal of the project.
- Location of the project.
- Time line for completion of the project.
- Materials needed.

Be creative! Use craft materials etc. Encourage the plan to be colourful and clear on what they are planning and why.

Review (15 minutes)

At the end of the lesson, post the plans on the wall for the class to see.

> *Ask*
>
> What were some of the challenges you faced creating a recovery/ rehabilitation plan?

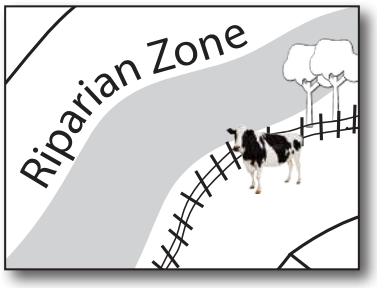
As the students leave, provide each student with the *Home Tips for Healthy Streams* pamphlet to take home to discuss with their parents.

Recovery and Rehabilitation

Because we know more about the importance of riparian areas to the health of watersheds, some riparian zones that have been damaged due to bad land use practices get **rehabilitated** (returned to original condition) through work done by volunteer groups, businesses and governments.

Example of rehabilitation project include:

- putting up fences along streams in agricultural lands so that farm animals can not walk in and damage the riparian zone
- putting rocks or log on stream banks that have been damaged



ACTIVITY: Open a magazine, book or go out to a local creek or lake and draw a cross-section of the riparian zone in the space below. Be specific - take note of the number and height of plants, evidence of animals, evidence of human impacts, type of stream banks etc. Circle the areas that are unhealthy in red and the areas that are healthy in green. On a separate piece of paper, describe a rehabilitation project that would improve the habitat within or along a river and how that would affect Nechako white sturgeon.

Lesson 2-6: Riparian Zones Field Trip

Time of Lesson: 2 hours (this time will vary depending on travel time and number of students attending)

Instruction Objectives: Student apply their classroom learning to the field.

Strategies and Activities: Students record observations and drawings of the riparian zone, do a species count and, if possible, a comparison between a mature and immature riparian zone.

Materials:

- Handout: *Worksheet 2c - Riparian Zones (if not completed in class in earlier lesson)*.
- Handout: *Worksheet 2h - Biodiversity Inventory*.
- Movie: *Murray Creek Restoration Project* at www.newssociety.org
- Pencils, clipboards, paper, class camera.
- Guest Speaker: please contact NWSRI for a list of possible guest speakers to accompany your class. Alternatively, if you know of any biologists please invite them to attend and lead the students through the material.
- A bus for transport if necessary.

Student Assessment:

- Participation in field trip.
- Ability to identify components of the riparian zone and measure biodiversity.
- Ability to identify areas along the riparian zone that may need rehabilitation and why.

Field Trip (1-1.5 hours)

After arriving at the field trip site, review safety issues as well as respecting the river, river banks and the environment.

Key Points

Do not remove anything from the site!

Take caution when walking along the riparian zone, do not intentionally destroy vegetation or in-stream structures like logs.

Do not throw rocks into the water - this disturbs fish and can harm eggs and young fish.

Do not leave garbage at the site.

Have students break into groups of 10-15 students. Potential activities per group include:

- walk and observation of the riparian zone (*Worksheet 2c - Riparian Zones optional)*
- talk about fish and fish habitat and link to Nechako white sturgeon (by biologist)
- conduct biodiversity inventory *(Worksheet 2h - Biodiversity Inventory)*

It is recommended that the biodiversity inventory continue during the entire field trip. This allows the students to more accurately record all the different plants and animals they see.

Optional Activity

Assign each group with a camera to visually record different aspects of the riparian zone and river habitat. In a journal or piece of paper, record with each photograph: what the pictures show (e.g. healthy riparian zone, fish, bird track, etc.); why they took that photo; and where it was along the site (e.g. looking upstream or downstream, river right or river left, top, middle or bottom part of site).

Back in the classroom, have each group organize their photographs into a slideshow. Have them present their slideshow on the SMARTboard to the class and describe what they saw and learned during the field trip.

The location of the field trip is up to the teacher. If the teacher knows of an easily accessible stretch of creek, please contact the NWSRI so they can add it to this list. Below are suggested field trip locations that provide good opportunities for students to learn about the riparian zone, fish habitat, links to Nechako white sturgeon, and rehabilitation projects.

Field Trip Option 1: Murray Creek, Vanderhoof

The Murray Creek Demonstration Site is a rehabilitated section of the upper section of Murray Creek. Murray Creek flows from the Blue Mountain hills through agricultural and residential lands to the Nechako River. It empties into the north side of the Nechako River just upstream of the Burrard Street bridge, right at the Migratory Bird Sanctuary and the only known sturgeon spawning site.

The Murray Creek Rehabilitation Project is a long standing local restoration project to improve the habitat along and within Murray Creek to enhance a long lost sport fishery of rainbow trout, to educate ranchers and farmers on best practices along creeks, to improve water quality in support of downstream populations of Nechako white sturgeon and chinook salmon, and to provide hands-on experience to students.

To Demonstration Site is located on private land, but is accessible for school groups. There is plenty of room for busses to access the site and turn around, and the walking for students and educators is easy-moderate. There is a large billboard at the site that explains all the work that has been done at this site, as well as a brochure. The brochure is available online at www.newssociety.com, and on the accomanying CD.

Learning objectives on this field trip can include:

- visual understanding of the riparian zone.
- able to see examples of rehabilitation within a riparian zone and creek.
- link upstream areas and how they can affect downstream resources (e.g. sturgeon do not live in Murray Creek, but the quality of the water in Murray Creek can affect sturgeon).
- potential to see fish and other animals in their natural habitat.
- good location to conduct *Worksheet 2h - Biodiversity Inventory*.

Water the short movie: *Murray Creek Restoration Project* at www.newssociety.org for a great overview of this project. Murray Creek is located about a 10 minute drive from downtown Vanderhoof. For directions please contact NWSRI.

Field Trip Option 2: Stoney Creek, Vanderhoof

Stoney Creek runs from Nulki Lake, over a series of falls into agricultural land, and then through residential Vanderhoof. It flows into the south side of the Nechako river at the Migratory Bird Sanctuary and then into the only known sturgeon spawning site.

Stoney Creek was part of the traditional fishery for Saik'uz First Nation. Chinook salmon and coho salmon spawn in this river.

There is a walking trail and bridge over Stoney Creek that is a easy walk and is in sight of the Nechako River. Stoney Creek provides a good example of a stream that

has direct impacts to the Nechako River. There are interpretive signs along the trail that speak to the positive and negative aspects of this river. The lower reach (along the trail) has been altered due to human impacts and the riparian zone is greatly impacted.

Learning objectives on this field trip can include:

- visual understanding of the riparian zone.
- obvious impacts from land use practices on the riparian zone and river habitat.
- linkage between improving habitat for salmon to allow greater food source for sturgeon.
- potential to see fish and other animals in their natural habitat, particularly from the walking bridge.
- interpretive signs add information about other aspects of the riparian zone.
- good location to conduct *Worksheet 2h - Biodiversity Inventory*.

Stoney Creek is located in Vanderhoof at the west end of Douglas Street. There is a bridge over the creek, with good access for busses. It is also walking distance from schools in downtown Vanderhoof.

Field Trip Option 3: Stellako River, Fraser Lake

The Stellako River is an important sockeye salmon spawning river. In the fall there are thousands of sockeye in the river for students to see. The river is very clear and access to the river at the gravel pit site* is possible for busses.

The Stellako River offers a good opportunity for students to see a relatively natural riparian zone. There is a trail along the river for students to explore the riparian zone.

The Stellako River feeds into Fraser Lake that Nechako white sturgeon have been known to use at different times of the year.

Learning objectives on this field trip can include:

- visual understanding of the riparian zone.
- link upstream areas and they can affect downstream resources.
- potential to see fish and other animals in their natural habitat.
- good location to conduct *Worksheet 2h - Biodiversity Inventory*.

*The Stellako River is located just west of Fraser Lake off of Francois Lake Road. For directions to the gravel pit site, please contact NWSRI.

Biodiversity Inventory

Biodiversity is the variety of life in the world or in a particular habitat or ecosystem. *The healthier the riparian zone, the greater the biodiversity.*

Conduct a biodiversity inventory (counting plants and animals) of a riparian zone. First, describe your riparian zone. Next write the names, draw a picture or use tally marks for each of the species you find in your site (evidence of an animal counts too, e.g. animals tracks). When you are done, what does your data tell you? Do you think this site is healthy or unhealthy? *OPTIONAL: Compare the biodiversity of an altered vs. unaltered or rehabilitated riparian zone to see if there is a difference in the number of species between the two habitats.*

Description of Riparian Zone	Biodiversity Inventory
Name of River: *Tributary to what river?*	*Plants*
What kind of riparian zone? ❑ *Altered* ❑ *Rehabilitated* ❑ *Mature* *Length of inventory site: _____ m* *Date of inventory: _____*	*Mammals*
	Fish, Reptiles and Amphibians
Do you think this is a healthy riparian zone? ❑ *Yes* ❑ *No* *WHY or WHY NOT?* _____ _____ _____ _____	*Birds*
	Invertebrates

UNIT 2 TEST

A number of test questions have been developed for this Unit. The questions include matching, labelling, True-False, and short answer in this document. Please feel free to customize the test for your class, considering the topics or materials you covered or focused on during the Unit.

You can find test questions for this Unit on the thumb drive that accompanies this curriculum:

- *Unit_2_Test.docx*

GRADE: _____ TEACHER: _____ SCHOOL: _____

Feedback Form for Unit 2

Please fill in the information below and return to the NWSRI. Please feel free to email any questions or comments to Lana Ciarniello at aklak@telus.net.

Background Information:

Is the information presented age appropriate and presented in an age appropriate manner? Yes or No

Was there enough information provided to conduct the lessons successfully?
Yes or No

If no, what additional information and/or resources would be useful?

Activities:

Were the activities engaging to the students? Yes or No

Was the timeline of the activities a good estimate?
Too Long ____ Too Short ____ Just Right ____

Any comments?

Worksheets:

Were the worksheets effective in teaching and/or reviewing the unit material?
Yes or No

Were the answer keys helpful? Yes or No

Additional Resources:

If used, were the resources suggested or provided for this unit useful? Yes or No

What else would you suggest be needed for this unit?